The effect of static magnetic field on some oral microorganisms (an in vitro study)

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Abstract

Several studies were done on magnetic attachment which used for retention of overdentures and these magnetic attachments fixed above the oral mucosa on dental implant or on precious metal root cap by cast bonding or cementing, these magnetic attachment may have effect on oral microorganism. This in vitro study investigated the effect of different static magnetic field strength on some oral microorganism. Oral swabs were taken from the lateral border of the tongue and buccal mucosas of the check from 10 students, growing culture were examined carefully and colony morphology was recorded. Gram stain and Lactophenol stain were used when suspected Fungi, isolated colonies were sub-cultured and these colonies identified by using different API systems, Streptococci mitis, Streptococci salivarius, Staph. aureus, Enterococci and Candida albicans identified and cultured and Then the effect of (50, 150,500,20,000 Gauss) static magnetic field strength were investigated on growth rate of these microorganism. The values obtained in this study were subjected to Analysis of Variance (ANOVA). Indicated that static magnetic field had an inhibitory effect on the growth rate of Strep. mitis and Strep. salivarius when the magnetic field strength used greater than (150 Gauss) at both South and North poles statistical analysis shows significant differences with control group. While in Enterococci and Staph. aureus and Candida albicans it showed an inhibitory effect on growth rate at North Pole with increasing in field strength above (150 Gauss) , while at South Pole it showed stimulatory effect on growth rate of these microorganisms with increasing field strength, both Poles showed significant differences with controlled group. While at (50 Gauss) field strength the results indicated no clear effect on culture growth rate for all microorganisms in the study. This study indicated that field strength of static magnetic greater than (50 Gauss) shows affect on growth rate of the oral microorganism which may affect the oral environment.

Introduction

Many studies indicated those magnetic fields have some biological effect on living [1-5]. The magnetic attachment which used for retention of overdentures and these magnetic attachment fixed above the oral mucosa on dental implant or on precious metal root cap by cast bonding or cementing [6,7,8] these magnetics may shows some effect on bacterials growth rate in the oral cavity. Study [9] showed that low level magnetic field induced increasing in the growth rate of Bacillus subtilis mutant strain when exposed to pulsatile electromagnetic field strength.

The effect of magnetic field was variable depending on the type of the microorganism and field. Research [10]on the effect of static magnetic field on Streptococcus mutans and Escherichia coli and their result indicated decrease in growth rate of Streptococcus mutans when cultured under anaerobic condition but their growth was not inhibited under aerobic conditions and there was no growth effect on E.coil cultures in both occasions. Many of these effects of magnetic field appear to be the consequence of interactions with cell membrane components and improving the enzymatic activity [9- 15].

Materials and methods

Isolation of oral microorganisms:-

Oral swabs were taken from the lateral border of the tongue and buccal mucosa of the check of the 10 students (5 males and 5 females) in the College of Dentistry in Hawler Medical University, it were inoculated on Blood agars, Sabouraud dextrose agars, incubated at 35c^{o} for 24-48 hours, because the specimens may contain mixtures of many different microorganisms identification of some of these microorganism were done.

Identification of microorganisms:- Growing culture were examined carefully and colony morphology were recorded. Then preparation of slides from these colonies were stained by gram stain or Lactophenol when suspected Fungi [16].Isolated colonies were sub-cultured and these colonies identified by using API 20 C yeast system when suspected fungi while for other bacteria were determined by using the API Strep.and API Staph. Systems in this study.

The following isolated organisms were used in this study:-

1. Streptococci mitis.
2. Streptococci salivarius.
3. Staph auerus.
4. Enterococci durans.
5. Candida albicans.

Counting method:- a numbers of colonies taken from the culture media and suspending them into (10 ml) normal saline in screw-capped tube ,mix the sample by shaking and the suspension prepared to o.5 McFarland solution. With a straight-sided pipette remove (1ml) of (15x $10^{7)}$ and deliver into the (9.0ml) tube labeled (15x10^{6}), with new pipette remove 1ml and transfer to the next dilution blank and so on till tube 15x10^{1}, place 0.1 ml with micropipette in the centre of a well-dried plate of agar medium and spread it with a loop over the entire surface in all direction. Special mark written on bottom of petridish for each microorganism and this procedure repeated for all micro organism used in this study. All the plates incubated at 35c° [17] except Candida albicans at 30c° [18].

Static magnetic field: - By using special magnetic plates of different thickness and size the following field strength was obtained (50,150, 500 and 20.000 Gauss) the magnetic field was measured at the area of culture media by Teslameter in order to obtain correct magnetic field strength.The experimental cultured group placed in the magnetic field with determination the north and south poles and it was placed with the control cultured group in the incubator at 35c° for 24 hours. Colony counter was used to determine the number of colonies on each culture medias and the resultant means was tabulated.

Results

Table (1) which showed the number of Streptococcus mitis growth rate within (50.150.500.20, 000 Gauss) at static magnetic field, from the table it shows that at (50 gauss) there was no effect on bacterial growth comparing to the control group, when the field strength increased there were a slight growth inhibition and it become significant ($p<0.01$) at field strength (150,500 and 20000 gauss) for both poles of magnetic field.

Streptococcus salivarius:-

Table (2) showed no effect of static magnetic field at (50 guess) on growth rate but it showed inhibition effect on growth rate which was increased with higher magnetic field strength. The table (2) shows significant differences for growth rate reduction when compared with control group ($P<0.01$) at field strength (150,500 and20,000 Gauss).

Staph. aureus:-

Table (3) showed no effect on growth rate at (50 gauss) in static magnetic field but there were slight inhibition effect on north pole which become more evidence at (20,000 Gauss) magnetic field. While at South Pole there was slight stimulant effect at (500 Gauss) which becomes more obvious at (20,000 Gauss). The table shows significant differences ($P<0.01$) in growth rate at field strength (150,500 and 20000 Gauss) for static magnetic field.

Entero cocci durans:-

Table (4) was showing no effect of the magnetic field at (50 gauss) while there was inhabitant effect on the bacterial growth and it was increased with increasing magnetic field strength at north pole while at the south pole it was showed stimulation on bacterial culture growth rate. Both poles of the magnetic shows significant differences in growth rate (P value <0.01) when compared with control group.

Candida albicans:-

Table (5) was showing no effect of magnetic field strength (50 Gauss) on the

growth rate of Candida albicans but it shows inhibition effect at (500 and 20000 Gauss) at north pole and stimulation effect on growth rate at south pole, statistically the both effects were significant ($p<0.01$).

Discussion

from tables (1 to 2) which showed that static magnetic field has slight inhibitory effect on the growth of Streptococcus at both pole especially at north pole, this inhibitory effect may be due to decrease in the metabolic activity of the bacterial cell and decrease in rate of replication of the cell DNA, this result agree with Victor[13] which shows same effect on some other types of bacteria. Tables (from 3 to 5) showed that the growth rate of Staph. aureus, Candida albicans and Enterococci decrease at north pole area but their growth rate were stimulated or increased at south pole field. This variant effect of both poles is agreed with [19] as he advocated the use of north pole for infection control. From these results conclude that south pole stimulates the microorganism replication and increase the metabolic activity and this effect was not obvious at 50 gauss for all types of microorganism but it becomes more obvious at higher field strength as shown in tables(from 1 to 5). this result agree with Kohno [10] as he showed in his studies decrease in growth rate of Streptococcus mutans when expose to pulsed magnetic field under anaerobic conditions and this effect may be due to more potent effect of pulsed magnetic field as it polarized and depolarized with each cycle of the current which lead to same effect on magnetic element or minerals in the cell according to Domain theory [20] and this may have effect on cell metabolism and replication, and this result agree withKate Melville [14] and Bokkon[15] as their result showed growth modification of bacteria when exposed to pulsed magnetic field.

References

1. Phillips JL, Campbell BM, Ivaschuk CO, Ishida JT, Haggnen LW. Exposure of molt-4 lymphoblastoid cells to a 1 G sinusoidal magnetic field at 60-Hz: effects on cellular events related to apoptosis. In. Annual Review of Research on Biological Effects of Electric and Magnetic Fields from the Generation, Delivery, and Use of Electricity. Frederick, MD:W/L Associates, Ltd. 1997.112-118.
2. Ahuja YR, Vijayashree BL, Saran RB, Jayashri EK. In vitro study, Effect of low frequency electromagnetic field on DNA in human leucocytes by comet. Assay. Indian J Biophys 1999; 36:318-322.
3. Svedenstal BM, Johanson KL, Mattsson MO, Paulson LE. DNA damage, cell kinetics and activities studied in mice exposed to electromagnetic fields generated by transmission lines. In Vivo, J Health Physic 1999; 13:507-514.
4. Inadian Gyan BF. The story of magneto therapy 2nd ed. Indian Gyan. Com Put- Ltd. (Indian Gyan.com) 2000. p.2-24.
5. Zmyslony M, Palus J, Jajte J, Dziubaltowska E, Rajkowska E. DNA damage in rat lymphocytes treated in vitro with iron cations and exposed to 7 mT magnetic fields (50 Hz). Mutat Res 2000;453:89-96.
6. Osama OM, Yukyo A, Masatumik L and Kohei K. Corrosion resistance of magnetic stainless keeper for dental magnetic attachment , J Den Res Tohoku University 2000; 43:23-25.
7. Shuiau YY. Magnetic attachment research in Asian region, clinical application of magnetic attachment Abstract of international symposium,J Jp Soc Oral Imp 2000; 1:29-36
8. Matsatoshi I, Toshiya K, Osamu Iand Tetsuo L. Installing magnetic keepers using laser welding. J prosthe Dent 2002; 11(1): 49-52.
9. Ceon R and Martin JT. low- level, magnetic field induced growth modification of Bacillus subtilis. J Bioelectromagnetics 2005; 8 (3):275-282.
10. Kohno MF, Yama ZA, Kimura I, Wafa MC. Effect of static magnetic field on bacteria streptococcus mutans and Escheriachia coli. J Am pathophysiology 2000; l7(2): 143-148.
11. Mandronero A S. influence of magnetic fields on calcium salts crystal formation. J Bio Med Res 1990; 12:627-634.
12. Stepanian AA, Barsegian ZH, Alaverdian GG, Oganesian LS, Markosian SN, Airapetion BK. The effect of magnetic

fields on the growth and division of Escherichia coli. J Clin Bio 2000 40(3): 319-322.
13. Victor Zeines FK. A patients Guide To magnetic. 2nd ed. London. Zenergy Com. (www.Natdent.com); 2000.p.7-12.
14. Kate Melville BC. Magnetic bacteria maintain their mystery. Naval, J Med. Laboratory Res 2006; 8:312-315.
15. Bokkon IK. Phosphene phenomenan, A new concept. J Biophy Res 2008; 92: 168-174.
16. Jawetez, ER, Melnick, JL, Adelberg EA, Brook GF, Butel, JS, and Morse SA. Medical Microbiology. 2nd ed. Middle East ed. Appleton and Lange. Norwalk, com. Alt. Califonia; 1998. p.67-69.
17. John KF and Mary LP. Microbiology Experiments. 4th ed. Pub. Mc Graw-Hill New York U.S.A; 2004. p.112-118.
18. Henery, JB. Yeast and yeast infections clinical diagnosis and management by laboratory methods 19th ed. Printed in UK by Butler& Tanner Ltd; 1996. p.1211-1251.
19. Dennis L M and Bekki MB. comprehensive guide to magnetic healing. 1st ed. Quintessence publishin , Medsker Med Division. Ltd. 2006. p.4-12.
20. Colin M. Text book of physics. Longman Revise Guides, 2nd ed.St Louis:CV Mosby; 1986. p.844-867.

Table (1): The effect of static magnetic field on growth rate of Streptococcus mitis.

Mag. Field Gauss.	Normal field Means±SE	N.pole Means±SE	S.pole Means±SE	P.v
50	296 ± 8 x 10^{-3}	297± 17 x 10^{-3}	298± 8 x10^{-3}	0.82
150	301 ± 8 x 10^{-3}	282± 12 x 10^{-3}	272± 14 x 10^{-3}	**
500	297 ± 5 x 10^{-3}	221± 8 x10^{-3}	242± 14 x 10^{-3}	**
20000	293 ± 8 x 10^{-3}	171± 8 x10^{-3}	181± 19 x 10^{-3}	**

Significant at P.value < 0.01 (*: Significant, **: Highly significant)

Table (2): The effect of static magnetic field on growth rate of Streptococcus salivarius

Mag. field gauss	Normal field Means±SE	N.pole Means±SE	S.pole Means±SE	P.v
50	311± 8 x 10^{-3}	312± 8 x10^{-3}	310± 6 x 10^{-3}	0.69
150	312± 3 x 10^{-3}	292± 14 x10^{-3}	295 ± 6 x10^{-3}	**
500	312± 8 x 10^{-3}	272± 15 x 10^{-3}	271± 8 x 10^{-3}	**
20000	312± 8 x 10^{-3}	181± 8 x10^{-3}	202± 11 x10^{-3}	**

Significant at P < 0.01 (*P: Significant, **P: Highly significant)

Table (3): The effect of static magnetic field on growth rate of Staph.aureus.

Mag. Field Gauss	Normal field Means±SE	N.pole Means±SE	S.pole Means±SE	P. v
50	311± 8 x 10^{-3}	311± 8 x 10^{-3}	312± 3 x 10^{-3}	0.57
150	312± 5 x 10^{-3}	283± 15 x 10^{-3}	333 ± 15 x 10^{-3}	**
500	312± 3 x 10^{-3}	274± 5 x 10^{-3}	391 ± 8 x 10^{-3}	**
20000	313± 5 x 10^{-3}	225 ± 3 x 10^{-3}	441± 5 x 10^{-3}	**

Significant at P < 0.01 (*P: Significant, **P: Highly significant)

Table (4): The effect of static magnetic field on growth rate of Enterococcus

Mag. Field Gauss	Normal field Means ±SE	N.pole Means ± SE	S.pole Means± SE	P. v
50	405± 5 x10^{-3}	401± 8 x10^{-3}	402± 5 x10^{-3}	0.02
150	403± 3 x10^{-3}	351± 8 x10^{-3}	396± 6 x10^{-3}	**
500	405± 12 x10^{-3}	291± 5 x10^{-3}	451± 8 x10^{-3}	**
20000	405± 5 x10^{-3}	262±11 x10^{-3}	481± 5 x10^{-3}	**

Significant at P < 0.01 (*P: Significant, **P: Highly significant)

Table (5): The effect of static magnetic field on growth rate of Candida albicans

Mag. Field Gauss	Normal of field Means±SE	N. pole Means±SE	S. pole Means±SE	P. v
50	401± 5 x10^{-3}	401± 5 x10^{-3}	421± 5 x10^{-3}	0.98
150	401±3 x10^{-3}	401± 5 x10^{-3}	421± 5 x10^{-3}	*
500	402± 5 x10^{-3}	381± 5 x10^{-3}	484± 8 x10^{-3}	**
20000	402± 3 x10^{-3}	342± 14 x10^{-3}	522± 14 x10^{-3}	**

Significant at P. value < 0.01